

WHAT IS CLAIMED IS:

1. A method for measuring low levels of a substance in a sample, said method comprising the steps of:

dispersing a plurality of paramagnetic particles in a colloidal solution;

5 introducing an amount of said colloidal solution into a sample chamber;

subjecting said sample chamber to a substantially uniform magnetic field;

forming at least one substantially linear structure
10 from said plurality of paramagnetic particles with said substantially uniform magnetic field;

introducing a sample having low levels of said substance to be measured into said sample chamber for analysis;

15 rotating said substantially uniform magnetic field at a constant rate to cause said substantially linear structure to rotate therewith;

binding a portion of said substance to be measured in said sample to said substantially linear structure;

20 detecting signals having a time-varying component originating from said sample chamber; and

processing said signals with a lock-in amplifier to measure said time-varying component by improving the

signal-to-noise ratio thereof using a reference signal
25 having a frequency twice that of the rotation of said
substantially uniform magnetic field as a multiplier to
measure said low levels of said substance to be measured.

2. A method as claimed in claim 1 wherein said
paramagnetic particles are coated with amine groups, and
wherein said substance to be measured in said sample binds
with said amine groups.

3. A method as claimed in claim 1 further comprising the
step of exposing said sample chamber to an excitation
source.

4. A method as claimed in claim 3 wherein said
excitation source is a light source.

5. A method as claimed in claim 4 wherein said light
source is a laser.

6. A method as claimed in claim 4 wherein said light
source is a light-emitting diode (LED).

7. A method as claimed in claim 4 wherein said signals having a time-varying component are detected with a photomultiplier (PM) tube.

8. A method as claimed in claim 4 wherein said signals having a time-varying component are detected with a charge-coupling device (CCD).

9. A method as claimed in claim 1 wherein said substantially uniform magnetic field is generated by a permanent magnet.

10. A method as claimed in claim 9 wherein said substantially uniform magnetic field is rotated by rotating said permanent magnet.